

HP StorageWorks

XP24000 Auto LUN Software User's Guide

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Revision History

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About this Guide

This user's guide describes and provides instructions for using the Auto LUN software.

The term *storage system* in this guide refers to an HP StorageWorks XP24000 Disk Array.

Intended Audience

This user's guide assumes that:

- the user has a background in data processing and understands RAID storage systems and their basic functions,
- the user is familiar with the storage system and the Remote Web Console computer,
- the user has read and understands the *HP StorageWorks XP24000 Remote Web Console User's Guide*, and
- the user is familiar with the operating system and web browser software on the system hosting the Remote Web Console software.

Related Documentation

For further information on the Remote Web Console computer, see the *HP StorageWorks XP24000 Remote Web Console User's Guide*, or contact your HP account team.

For details on the applicable operating systems and web browser software, see *HP StorageWorks XP24000 Remote Web Console User's Guide*.

You can find related HP StorageWorks documents from the Manuals page of the HP Business Support Center website:

<http://www.hp.com/support/manuals>.

In the Storage section, click **Storage Software** and then select the product.

Document Conventions

Table 1 Document Conventions

Convention	Element
Blue text: Table 1	Cross-reference links and e-mail addresses
Blue, underlined text: http://www.hp.com	Website addresses
Bold text	<ul style="list-style-type: none">• Text emphasis• UI elements

Conventions for Storage Capacity Values

HP XP storage systems use the following values to calculate physical storage capacity values (hard disk drives):

- 1 KB (kilobyte) = 1,000 bytes
- 1 MB (megabyte) = 1,000² bytes
- 1 GB (gigabyte) = 1,000³ bytes

- 1 TB (terabyte) = 1,000⁴ bytes

HP XP storage systems use the following values to calculate logical storage capacity values (logical devices):

- 1 KB (kilobyte) = 1,024 bytes
- 1 MB (megabyte) = 1,024² bytes
- 1 GB (gigabyte) = 1,024³ bytes
- 1 TB (terabyte) = 1,024⁴ bytes
- 1 block = 512 bytes

Window Illustrations

The windows shown in this guide were displayed on a Windows computer with the Internet Explorer browser. The windows may appear different on your computer depending on the operating system and browser being used. Window contents also vary depending on installed program products and the storage system being managed.

HP Technical Support

For worldwide technical support information, see the HP support website:

<http://www.hp.com/support>

Before contacting HP, collect the following information:

- Product model names and numbers
- Technical support registration number (if applicable)
- Product serial numbers
- Error messages
- Operating system type and revision level
- Detailed questions

Subscription Service

HP recommends that you register your product at the Subscriber's Choice for Business website:

<http://www.hp.com/go/e-updates>

After registering, you will receive e-mail notification of product enhancements, new driver versions, firmware updates, and other product resources.

HP Websites

For additional information, see the following HP websites:

- <http://www.hp.com>
- <http://www.hp.com/go/storage>
- http://www.hp.com/service_locator
- <http://www.hp.com/support/manuals>

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1 Overview of HP StorageWorks XP Auto LUN Software

Auto LUN lets you balance workload among hard disk drives, volumes (LUs) and processors to remove bottlenecks from your system. If Performance Monitor indicates that a large number of I/Os are made to some hard disk drives, you can use Auto LUN to distribute workloads to other disk drives. For details, see ["Overview of Auto LUN" on page 11](#).

Figure 1 on page 10 illustrates and simplifies the performance management process.

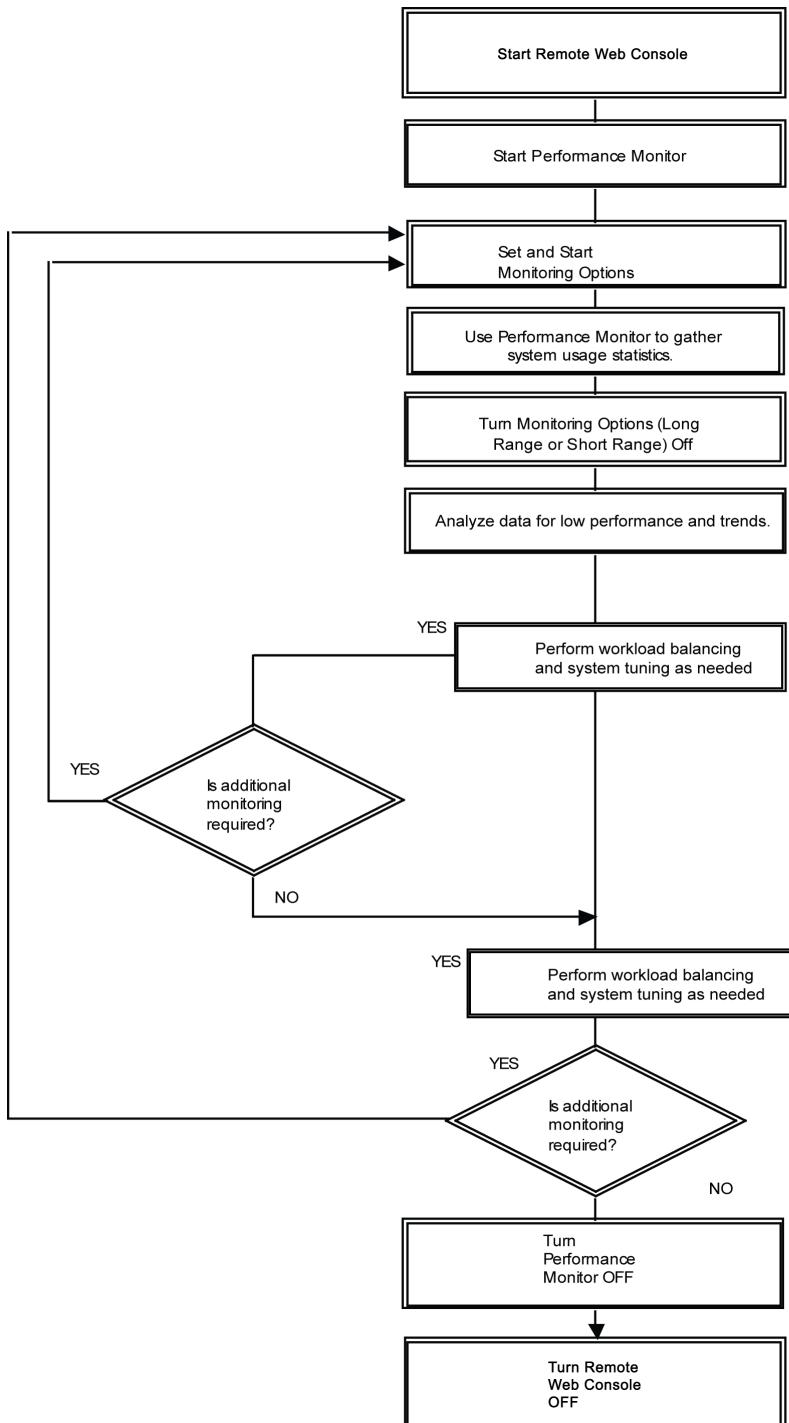


Figure 1 Performance Management Process Flow Diagram

2 About Auto LUN Operations

Components

To use Auto LUN, you need:

- the storage system
- the Auto LUN program product (Performance Monitor is required.)
- a WWW client computer connected to the storage system via LAN

To use Auto LUN, you must use the WWW client computer to log on to the SVP. When you are logged on, the HP StorageWorks XP Remote Web Console program, which is a Java application program, will be downloaded to the WWW client computer. You can perform Auto LUN operations in the Remote Web Console window.

For details about requirements for WWW client computers, see *HP StorageWorks XP24000 Remote Web Console User's Guide*.

Cautions:

- If Performance Monitor is not enabled, you cannot use Auto LUN or Performance Control.
- Performance management operations (Performance Monitor, Auto LUN, and Performance Control) involve the collection of large amounts of monitoring data. This requires considerable web client computer memory. It is therefore recommended that you exit the Remote Web Console program when not conducting performance management operations, to release system memory.

Overview of Auto LUN

Auto LUN enables you to optimize your data storage and migrate volumes on the storage system. Auto LUN tuning operations can be used to balance resource utilization and resolve bottlenecks of system activity.

Auto LUN to Balance Workloads

If I/O accesses from hosts converge on particular hard disk drives, the hosts might suffer from slower response times. To overcome this situation, Auto LUN lets you migrate high-usage volumes to a low-usage hard disk drive or a fast hard disk drive. Volume migration can balance workloads among hard disk drives and thus remove bottlenecks from the system. Volume migration can also balance workloads among disk processors, which control disk I/Os.

Note:

- Manual migration supports external volumes, but you cannot examine the estimated usage rate after migration because the usage rates of external volumes cannot be collected. For details on external volumes, see the *HP StorageWorks XP24000 Performance Monitor User's Guide*.
- Auto LUN operations are completely nondisruptive - the data being migrated can remain online to all hosts for read and write I/O operations throughout the entire volume migration process. Keep in mind that storage system-tuning operations can improve performance in one area while at the same time decreasing performance in another. Suppose that parity groups A and B have average usage values of 20% and 90%, respectively. Auto LUN estimates that if one volume is migrated from parity group B to parity group A, the usage values will become 55% and 55%. If you perform this migration operation, the I/O response time for parity group B will probably decrease, and the I/O response time for parity group A may increase, while the overall throughput may increase or decrease.
- Auto LUN should be performed only when you can expect a large improvement in storage system performance. Auto LUN may not provide significant improvement for cases in which parity

group or volume usage varies only slightly, or for cases in which overall DKP or DRR usage is relatively high.

- From an open-system host, users can also use HP StorageWorks XP RAID Manager to perform manual volume migration by using commands. To perform volume migration by RAID Manager, Auto LUN should be installed on the storage system. For details on manual volume migration by using RAID Manager, see “[Using RAID Manager for Manual Volume Migration](#)” on page 45. For details on RAID Manager, see *HP StorageWorks XP RAID Manager User’s Guide*.

Caution: When an error condition exists in the storage system, resource usage can increase or become unbalanced. Do not use data collected during an error condition as the basis for planning Auto LUN operations.

Manual Volume Migration

Auto LUN enables you to balance workloads among parity groups to improve system performance. To balance workloads, you select high-usage volumes from a high-usage parity group and then move the volumes to a different parity group.

This section explains how to migrate volumes in parity groups manually, citing usage rates before and after migration.

Note: You can also migrate an external volume manually. However, you cannot examine the estimated usage rate after migration because the usage rate of an external volume cannot be collected.

Before migrating a volume from one parity group to another, you must create a migration plan. When you create a migration plan, you specify the following:

- a volume for migrating
- the migration destination for the specified volume

To migrate volumes, you execute your migration plan.

[Figure 2](#) on page 12 gives an example of a migration plan as it would be displayed in the **Manual Plan** window of Auto LUN. In this figure, **Source LDEV** indicates the volume that should be migrated. **Target LDEV** indicates the migration destination for the volume in **Source LDEV**.

Stat	DEL	%	Source LDEV								Target LDEV							
			LDEV	Emulation	Capacity	RAID	PG	HDD	CLPR	LDEV	RAID	PG	HDD	CLPR	Owner			
*	*	*	00:02:00	OPEN-V	2.28 GB	NAA	2-1	DKR1B-NMIFC	00:CLPR0	00:05:09	NAA	2-2	DKR1B-NMIFC	00:CLPR1	XP24			

Figure 2 An Example of Migration Plans Displayed in the Auto LUN Window

Before you create a migration plan, you must determine which volume should be migrated to which parity group. When you determine a volume to be migrated, do the following:

- Check usage rates for volumes ([Figure 3](#) on page 12).
- Choose a volume to be migrated from among high-usage volumes.

Manual Migration Plans			LDEVs						
			LDEV	Emulation	Capacity	Ave.(%)(Total)	Max.(%)	Target	
Subsystem			00:00:00	OPEN-V	2.28 GB	-	-		
Parity Group			00:00:01	OPEN-V	2.28 GB	-	-		
1-1[5-5](/- %, 00:CLPR0)			00:00:02	OPEN-V	2.28 GB	-	-		
1-2[5-1:5-2](/- %, 01:CLPR1)			00:00:03	OPEN-V	2.28 GB	-	-		
1-3[5-3:5-4](/- %, 02:CLPR2)			01:00:04	OPEN-V	2.28 GB	-	-		
1-4(/- %, 03:CLPR3)			01:00:05	OPEN-V	2.28 GB	-	-		
2-1(/- %, 00:CLPR0)			01:00:06	OPEN-V	2.28 GB	-	-		
2-2(/- %, 01:CLPR1)			01:00:07	OPEN-V	2.28 GB	-	-		
3-1(/- %, 02:CLPR2)									
3-2(/- %, 03:CLPR3)									

Figure 3 Usage Rate for a Volume Displayed in the Window

- After determining a migration destination, find fast parity groups (that is, fast hard disk drives). Next, you should choose a low-usage parity group from the fast parity groups.

To find fast hard disk drives, display the **Auto LUN** window and check *classes* (Figure 4 on page 13). *Classes* indicate disk access speed for parity groups. Fastest parity groups (or groups of fastest disks) belong to class A. Parity groups in class B are not as fast as parity groups in class A, but are faster than parity groups in class C. Parity groups in higher classes (such as class A) provide faster disk access than parity groups in lower classes (such as class C). **Note:** In the storage system documentation, the terms *class* and *HDD class* mean the same thing.

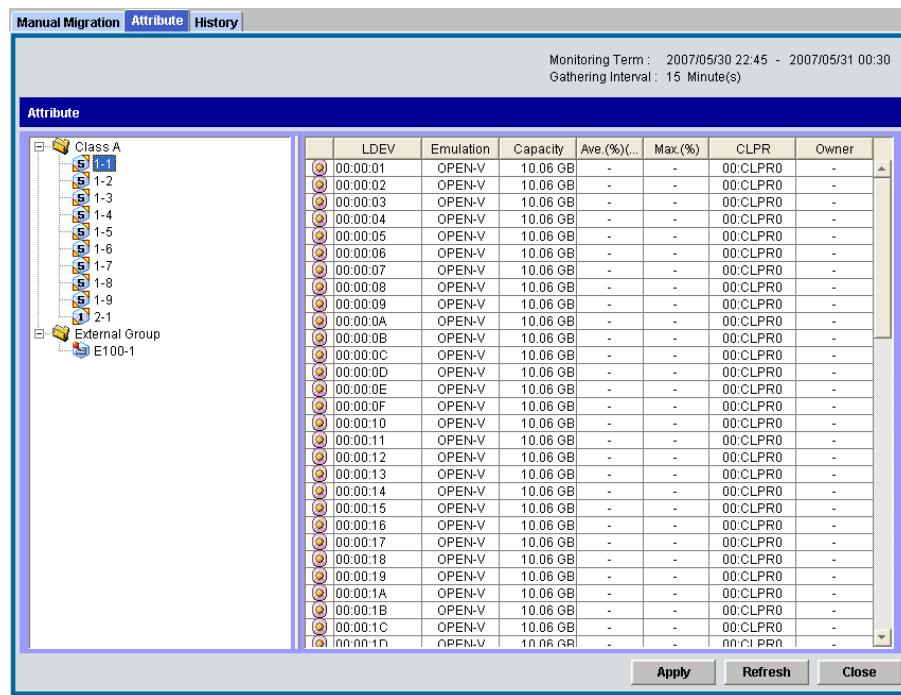


Figure 4 Classes and Parity Groups that Appear in the Auto LUN Window

Next, you should choose a low-usage parity group from the fast parity groups. You can find low-usage volumes in the **Auto LUN** Window (see Figure 5 on page 13 below).

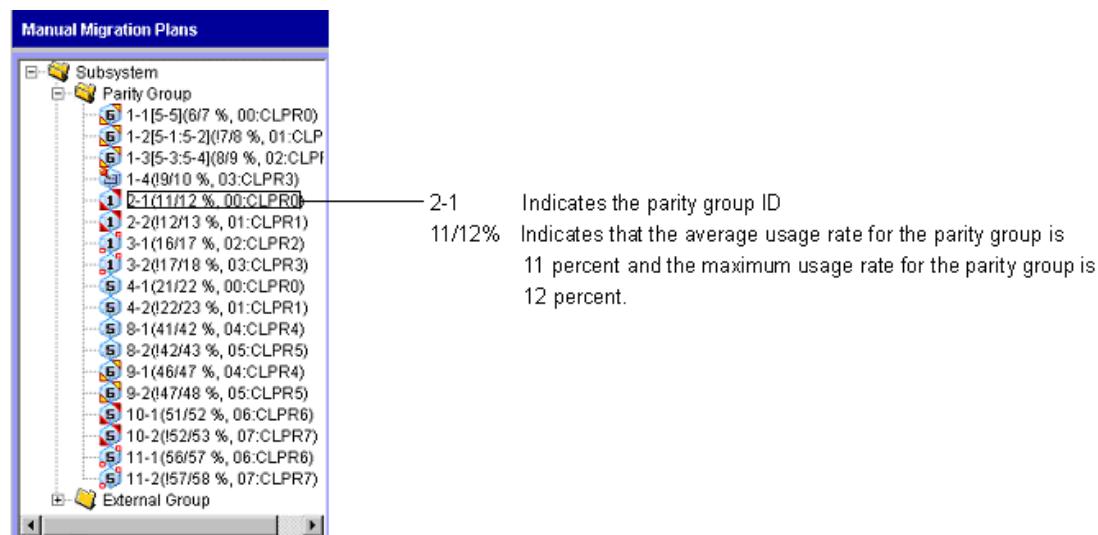


Figure 5 Parity Group Usage Displayed in the Auto LUN Window

Next, display the contents of the low usage parity group and then look for disk areas preceded by the icons. From the disk areas, choose the destination disk area

Notes: When you use Auto LUN for the first time, you must reserve volumes for migration destinations in advance. These reserved volumes are marked with the icon. When you specify a volume to be migrated, icons of some reserved volumes () that can be used as a migration destination will change to the icons. For details on reserving volumes for migration destinations, see “Reserving Migration Destinations For Volumes” on page 41.

If you specify the volume you want to migrate in the window and click **Target**, Auto LUN displays the list of disks of the parity groups that can be used as destinations. If you select the destination disk area and click **Graph**, Auto LUN calculates the estimated volume usage rate after migration, and displays the estimated usage rate in the window (see [Figure 6](#) on page 14). However, Auto LUN cannot estimate the usage rate of any external volumes. In case of migrating an external volume, the transition of the external volume usage rate is not displayed even if you click **Plan**. If the volume usage rate of the migration source cannot be calculated or if you do not need to know the transition of the usage rate, you can migrate the volume without displaying the graph.

Auto LUN uses past resource usage rates, hard disk drive type information, and the RAID level to calculate the estimated usage rate. In the example in [Figure 6](#) on page 14, if the volume 00:03:06 in the parity group 2-1 is migrated to the reserved volume 01:01 in the parity group 1-2, the parity group 2-1 can expect 10 percent decrease in the average usage rate (from 21 percent to 11 percent). The destination parity group 1-2 can expect a 13 percent increase in the average usage rate (from 12 percent to 25 percent). If the estimated result is not satisfactory, you can change the migration destination.

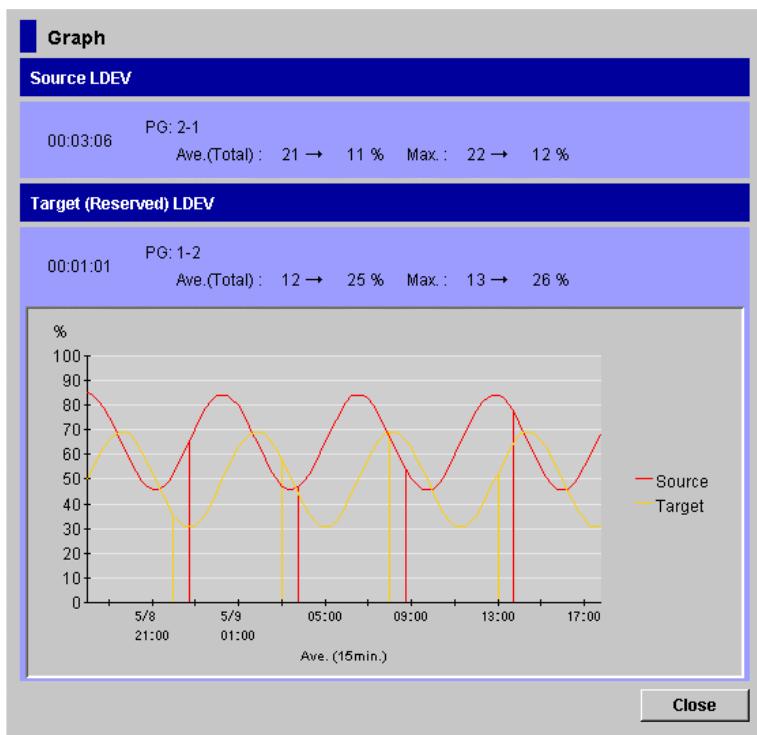


Figure 6 Estimated Usage Rate for Parity Groups

You can create multiple migration plans. If there are any other high-usage volumes, you can continue to create migration plans. If you finish creating migration plans, you can execute the migration plans to start volume migrations.

For more detailed information about volume migrations, see “[Migrating Volumes Manually](#)” on page 42.

Hosts can perform I/O operations on volumes that are being migrated. This section explains why.

Note: The storage system documents (including this manual) use the term *source volumes* to refer to volumes that should be migrated. The term *target volumes* is used for volumes that should become migration destinations.

The Auto LUN operation consists of two steps:

- Copy the data on the Auto LUN source volume to the Auto LUN target volume (see [Figure 7](#) on page 15).
- Transfer host access to the target volume to complete the migration (see [Figure 8](#) on page 16).

The Auto LUN source volume can be online to hosts during migration. The target volume is reserved prior to migration to prevent host access during migration. The source and target volumes can be located anywhere within the storage system.

The Auto LUN copy operation copies the entire contents of the source volume to the target volume cylinder by cylinder (24 tracks at a time, not including the diagnostic and unassigned alternate tracks). If the source volume is updated by write I/Os during the copy operation, the updates will be recorded on the cylinder map of a volume. If there are differential data formed by the update, the differential data will be copied from the source volume to the target volume and this will be repeated until all differential data on the source volume is copied. However, there are upper limits to the number of times the copy is executed and the limit depends on the capacity of the migrated volume. The limit increases as the capacity of the migrated volume increases. When the differential data still exists after copy is repeated to the upper limit, the volume migration fails. Execute the migration by reducing the workloads between hosts and the storage system. The indication of the workloads between hosts and the storage system must be 50 IOPS or below for updating I/O.

When the volumes are fully synchronized (that is when there is no differential data on source volume), the storage system completes the migration by swapping the reserve attribute (target is normal, source is reserved) and redirecting host access to the target volume. Auto LUN performs all migration operations sequentially (that is one volume migration at a time).

Note: Approximate copy times with no other I/O activity are OPEN-3 = 1.5 min, OPEN-9 = 4.5 min, OPEN-E = 9 min.

Note: For manual migration operations, Auto LUN checks the current storage system write pending rate and cancels a migration operation if the write pending rate is higher than 60%.

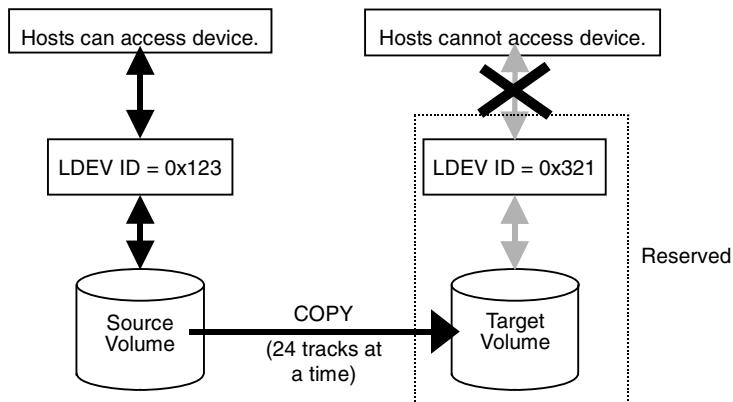


Figure 7 Data Flow during an Auto LUN Operation

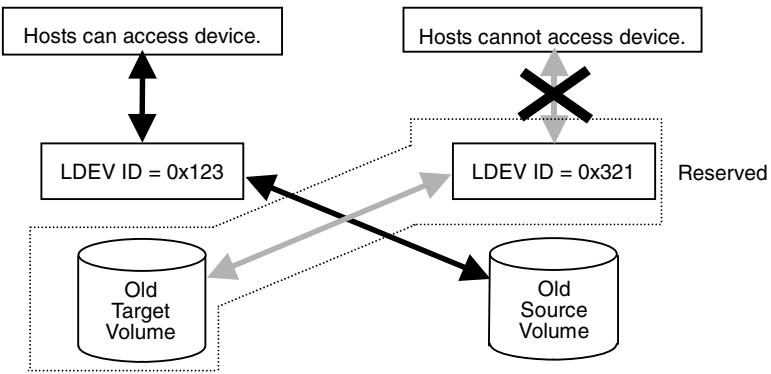


Figure 8 Data Flow after an Auto LUN Operation

Note: Immediately after a volume to be migrated and a volume of a migration destination replace each other, RAID level before the replacement might be displayed or an internal error might occur in the storage system. In this case, select the **Refresh** button to update the display of the window.

Interoperability with Other Products

Auto LUN

The requirements and restrictions for performing Auto LUN operations are:

- **User types.** If the user type of your user ID is *storage partition administrator*, you cannot use Auto LUN. For details on the limitations when using Performance Monitor logged in as a storage partition administrator, see the *HP StorageWorks XP24000 Performance Monitor User's Guide*.
- **Combinations of volumes.** The source and target volumes must be managed by the same storage system. (An external volume can be used for source or target volume.) Also, a combination of source and target volumes should satisfy the following conditions:
 - The **LDKC:CU:LDEV** numbers of volumes take the value between 00:00:00 and 00:FE:FF or between 01:00:00 and 01:FE:FF.
 - The source and target volumes have the same emulation type and capacity.
 - If the emulation type is not OPEN-V, both the source and target volumes are *custom-sized volume* (CV), or both the volumes are normal volumes.
- Specify the volumes that satisfy the conditions above as the source and target volumes. The source and target volumes must be specified by LDEV ID, not VOLSER or port/TID/LUN.
- **Source volumes.** The following volumes cannot be used as source volumes:
 - Volumes set as command devices (reserved for use by the host).
 - Volumes which are in an abnormal or inaccessible condition (for example, pinned track, fenced).
 - Volumes used by the IBM 3990 Concurrent Copy (CC) host software function.
 - Volumes which have HP StorageWorks XP Cache Residency Manager data or Cache Residency Manager for Mainframe data stored in cache.
 - Volumes used by HP StorageWorks XP Continuous Access Journal Software or Universal Replicator for Mainframe as a journal volume.
 - Volumes which are reserved by a migration program other than Auto LUN.
 - Volumes on which RAID Manager is performing volume migration operation.
 - Volumes that form an HP StorageWorks XP Snapshot pair.
 - Virtual volumes and pool volumes that are used by XP Snapshot.
 - Virtual volumes and pool volumes that are used by HP StorageWorks XP Thin Provisioning.
 - Volumes being shredded.

TrueCopy for Mainframe: If the status of a TrueCopy for Mainframe volume is *suspended* or *simplex*, the volume can be used as a source volume. If not, the volume cannot be used as a source volume. When a TrueCopy for Mainframe volume is deleted from the MCU, the status of both volumes changes to *simplex*, and both volumes can be used as source volumes. When a TrueCopy for Mainframe volume is deleted from the RCU, the status of the M-VOL changes to *suspended* and the status of the R-VOL changes to *simplex*, and both volumes can be used as source volumes. Note that if you specify a TrueCopy for Mainframe volume as a source volume, you cannot specify an external volume as the target volume.

HP StorageWorks XP Continuous Access Software: If the status of a Continuous Access volume is PSUS, PSUE, or SMPL, the volume can be used as a source volume. If not, the volume cannot be used as a source volume. When a Continuous Access pair is deleted from the MCU, the status of both volumes changes to SMPL, and both volumes can be used as source volumes. When a Continuous Access pair is deleted from the RCU, the status of the P-VOL changes to PSUS and the status of the S-VOL changes to SMPL, and both volumes can be used as source volumes. Note that if you specify a Continuous Access volume as a source volume, you cannot specify an external volume as the target volume.

Universal Replicator for Mainframe: If the status of a Universal Replicator for Mainframe volume is Pending duplex or Duplex, the volume cannot be used as a source volume. Note that if you specify a Universal Replicator for Mainframe volume as a source volume, you cannot specify an external volume as the target volume.

Continuous Access Journal: If the status of a Continuous Access Journal volume is COPY or PAIR, the volume cannot be used as a source volume. Note that if you specify a Continuous Access Journal volume as a source volume, you cannot specify an external volume as the target volume.

ShadowImage for Mainframe and HP StorageWorks XP Business Copy Software: Usage of ShadowImage for Mainframe and Business Copy volumes as a source volume depends on the status and cascade configuration of the volume as described below.

- The following volumes cannot be used as a source volume:
 - ShadowImage for Mainframe volumes whose status is SP-Pend or V-Split.
 - Business Copy volumes whose status is COPY(SP) or PSUS(SP).
- [Table 2](#) on page 17 specifies which non-cascade volumes can be used as source volumes.

Table 2 Non-Cascade Volumes and Auto LUN Source Volumes

Pair Configuration [Status ≠ COPY(SP) or PSUS(SP)]	Can P-VOL be used as a source volume?	Can S-VOLs be used as source volumes?
Ratio of P-VOL to S-VOLs is 1:1	Yes	Yes
Ratio of P-VOL to S-VOLs is 1:2	Yes	Yes
Ratio of P-VOL to S-VOLs is 1:3	No	Yes

- [Table 3](#) on page 17 specifies which cascade volumes can be used as source volumes.

Table 3 Cascade Volumes and Auto LUN Source Volumes

Pair Configuration [Status ≠ COPY(SP) or PSUS(SP)]	Can P-VOL be used as a source volume?	Can S-VOLs be used as source volumes?
L1 pair, ratio of P-VOL to S-VOLs is 1:1	Yes	Yes
L1 pair, ratio of P-VOL to S-VOLs is 1:2	Yes	Yes
L1 pair, ratio of P-VOL to S-VOLs is 1:3	No	Yes
L2 pair, ratio of P-VOL to S-VOLs is 1:1	Yes	No
L2 pair, ratio of P-VOL to S-VOLs is 1:2	No	No

Caution: If any of the following operations is performed on an Auto LUN source volume during migration, the volume migration process stops:

- CC operation.

- TrueCopy for Mainframe operation that changes the volume status to something other than suspended or simplex.
- Continuous Access operation that changes the volume status to something other than PSUS, PSUE, or SMPL.
- Continuous Access Journal operation or Universal Replicator for Mainframe operation that changes the volume status to COPY.
- ShadowImage for Mainframe operation that changes the volume status to SP-Pend or V-Split.
- Business Copy operation that changes the volume status to COPY(SP) or PSUS(SP).
- Continuous Access Journal operation or Universal Replicator for Mainframe operation.
- **Expanded LUs as source volumes.** To specify an expanded LU as a source volume for migration, you can specify individual LDEVs within the expanded LU (for example, LDEVs with high usage), and Auto LUN will migrate only the specified LDEVs. If desired, you can also specify all LDEVs of the expanded LU to relocate the entire expanded LU. In this case, you must make sure that the required reserved target LDEVs are available.
- **Target volumes.** Target volumes must be reserved prior to migration using the Auto LUN software. Hosts cannot access reserved volumes.
The following volumes cannot be reserved as target volumes:
 - Expanded LUs
 - Volumes which are set as command devices (devices reserved for use by the host).
 - Volumes which are assigned to Business Copy or Continuous Access pairs.
 - Volumes which are used by the IBM 3990 Concurrent Copy (CC) host software function.
 - Volumes which are reserved for Business Copy operations.
 - Volumes which have Cache Residency Manager data or Cache Residency Manager for Mainframe data stored in cache.
 - Volumes used by Continuous Access Journal or Universal Replicator for Mainframe as a data volume or journal volume.
 - Volumes in which HP StorageWorks XP Volume Retention Manager specified the Read Only or Protect attribute.
 - Volumes which HP StorageWorks XP Volume Security disabled to be used as secondary volumes.
 - Volumes which Data Retention Utility specified the Read Only or Protect attribute, or disabled to be used as secondary volumes.
 - Volumes which are reserved by a migration program other than Auto LUN.
 - Volumes on which RAID Manager is performing volume migration operation.
 - Volumes that form a XP Snapshot pair.
 - Virtual volumes, XP Thin Provisioning volumes and pool volumes.
 - Volumes which are in an abnormal or inaccessible condition (for example, pinned track, fenced).

You can also reserve external volumes as target volumes. However, if you specify a TrueCopy for Mainframe volume or Continuous Access volume as a source volume, you cannot specify an external volume as the target volume.

- **Number of migration plans that can be executed concurrently:** In manual migration, the number of migration plans that can be executed concurrently might be restricted depending on the usage of other storage system programs, and also depending on the emulation types and sizes of the migrated volumes.

Auto LUN uses the *differential tables* to manage differentials occurred by write operation while migrating volumes. Differential tables are the resources shared by XP Snapshot, Auto LUN, Business Copy, ShadowImage for Mainframe, HP StorageWorks XP for Compatible FlashCopy Mirroring, and Compatible FlashCopy V2. Therefore, the maximum number of differential tables that Auto LUN can use is the number of total differential tables in the storage system minus the number of that used by other programs.

Moreover, the number of differential tables needed to migrate one volume differs depending on the emulation type and size of the volume. Thus, the maximum number of migration plans that

can be executed concurrently changes depending on the number of differential tables that Auto LUN can use, and depending on the emulation types and sizes of volumes to be migrated. For details on how to calculate the number of migration plans that can be executed concurrently, see "[How to Calculate the Number of Concurrent Migration Plans](#)" on page 20. For details on the number of differential table required for migrating a volume, see "[Calculating Differential Tables Required for Mainframe Volume Migration](#)" on page 21 and "[Calculating Differential Tables Required for Open-System Volume Migration](#)" on page 22.

- **Manual migration execution.** Auto LUN will **not** execute a manual migration operation when the current write pending rate for the storage system is 60% or higher.

- **If heavy workloads are imposed on your storage system:** Avoid volume migration operations when heavy workloads are imposed onto your storage system due to I/O requests from hosts. If you should perform volume migration, the migration could fail. If migration fails, reduce the workloads on your storage system and then retry volume migration.

Copy Threshold Option: If the load of storage system increases, host server I/O performance (response) may be degraded. If Auto LUN performs migration operations when the load of storage system is heavy, it is more likely that host server I/O performance (response) may be degraded. The Copy Threshold option temporarily stops Auto LUN operation when the load of the storage system is heavy. If you set this option in effect, you can minimize the degradation of host I/O performance (response) by temporarily stopping Auto LUN operations when the load of the storage system is heavy.

Migration of this volumes is likely to fail when hosts frequently update volumes being migrated. If you set the Copy Threshold option in effect, this option temporarily stops the copy processing of Auto LUN when the load of the storage system is overloaded, thus increasing the possibility of failure in migration of volumes. For this reason, we do not recommend you use this option when hosts frequently update volumes being migrated.

For information about the setting of the Copy Threshold option, call HP technical support.

Note: Copy operations that are stopped by the Copy Threshold option will resume when the load of the storage system become light. If this option is in effect, not only Auto LUN operation but also the copy operations of the following program products will stop when the load of the storage system is heavy.

- Business Copy
- ShadowImage for Mainframe
- Compatible FlashCopy
- Compatible FlashCopy V2
- XP Snapshot

- **Progress Value :** It is possible that migration is unfinished even though an Auto LUN window shows that migration is 100 percent finished. This problem can occur particularly when a volume with heavy workloads for update I/Os between hosts and the storage system and a volume with light workloads for update I/Os between hosts and the storage system are migrated together, a migration plan which the migration of the volumes will not complete even the progress value becomes 100% may be formed. If this problem occurs, execute either of the following to migrate the volumes.

- Reduce the workloads for update I/Os between hosts and the storage system and complete the migration.
- Stop the volume migration for the volume with heavy workloads for update I/Os between hosts and the storage system, execute a migration of another volume and then retry the migration which has been stopped.

- **Effects on Other Program Products :** When the workloads for update I/Os between hosts and the storage system are heavy, longer time will be required to complete the volume migration because the copy of differential data is repeatedly executed. Longer copying time may be required for other program products when this copy of differential data is executed. See [Table 4](#) on page 20 for the amount of affected copying time of other program product. The copying time of other program products depends on the number of pairs set to the program product, however, the copying time may be increased up to twice.

The term other program products refers to the following program products.

- Auto LUN
- Business Copy

- ShadowImage for Mainframe
- Compatible FlashCopy

Table 4 The capacity of migrated volume and the estimated delay in the copying speed

Capacity of Migrated Volume (MB)	Estimated delay in the copying speed (in minutes)
0 - 1,000	4
1,001 - 5,000	18
5,001 - 10,000	37
10,001 - 50,000	186
50,001 - 100,000	372
100,001 - 500,000	1,860
500,001 - 1,000,000	3,720
1,000,001 - 2,150,400	9,667

The above estimates are calculated based on the assumption that the workload for update I/Os for the migrated volume is 50 IOPS for one volume.

- **Maintenance.** Do not perform Auto LUN migration operations during storage system maintenance activities (for example, installation, replacement, or uninstallation of cache or drives, or replacement of the microcode).
- **Notes on powering off the storage system:** To turn the power off at the storage system, confirm whether migration of volumes is finished. If migration is unfinished, it is strongly recommended that you do not turn off the power until the migration is finished. If you turn the power off when migration is in progress, data migration stops and some of the data are not migrated. If you turn the power on later, Auto LUN resumes data migration. If the data remains in the shared memory (which is a volatile memory), Auto LUN attempts to copy only the data that have not been migrated to the migration destination. However, if data is lost from the shared memory, Auto LUN attempts to copy all the data to the migration destination and thus the copy operation would take a lot of time; Auto LUN attempts to copy data that have not been migrated, and also attempts to copy data that have already been copied to the migration destination.

Note: The storage system documentation sometimes uses the term **PS ON**, which refers to an operation for turning on the power supply to the storage system. Also, the 9900 documentation sometimes uses the term **PS OFF**, which refers to an operation for turning off the power supply to the storage system.

How to Calculate the Number of Concurrent Migration Plans

In using Auto LUN for manual volume migration, the number of migration plans that can be executed concurrently might be restricted. The number of migration plans that can be executed concurrently depends on the following conditions.

- How much shared memory is available for differential tables:
You can install additional shared memory for differential tables.
You may use 26,176, 57,600, 104,768, 146,688, or 209,600 differential tables if additional shared memory for differential tables is installed.
To install additional shared memory for differential tables, call HP technical support.
- How much shared memory is available for pair tables:
You can install additional shared memory for differential tables.
You may use 8,192 or 16,384 pair tables if additional shared memory for pair tables is installed.
To install additional shared memory for pair tables, call HP technical support.
- The emulation type and capacity of each volume to be migrated:
The number of differential tables and pair tables needed to migrate one volume differs depending on the emulation type and size of the volume. For the number

of differential tables and pair tables needed for migrating a mainframe volume, see “[Calculating Differential Tables Required for Mainframe Volume Migration](#)” on page 21. For the number of differential tables needed for migrating an open-system volume, see “[Calculating Differential Tables Required for Open-System Volume Migration](#)” on page 22.

You can estimate the maximum number of migration plans that can be executed concurrently by applying the above conditions into the following equation:

- $\Sigma(\alpha) \leq (\beta)$ and $\Sigma(\gamma) \leq (\delta)$

$\Sigma(\alpha)$ stands for the total number of differential tables needed for migrating all volumes

(β) stands for the number of differential tables available in the storage system.

$\Sigma(\gamma)$ stands for the total number of pair tables needed for migrating all volumes.

(δ) stands for the number of pair tables available in the storage system.

For example, if you want to create 20 migration plans of OPEN-3 volumes (size of a volume is 2,403,360 kilobytes), the number of required differential tables is 3, and the number of pair tables is 1, as calculated by the equation in section

“[Calculating Differential Tables Required for Open-System Volume Migration](#)” on page 22.

$$[(3 \times 20) = 60] \leq 26,176 \text{ and } [(1 \times 20) = 20] \leq 8,192$$

Since this equation is true, you can create all the migration plans that you want to create.

In this section, we mentioned the calculation of the maximum number of migration plans when only Auto LUN is running. However, in fact, the total number of differential tables used by XP Snapshot, Business Copy, ShadowImage for Mainframe, Compatible FlashCopy, Compatible FlashCopy V2, the total number of pair tables used by Business Copy, ShadowImage for Mainframe, Compatible FlashCopy and Auto LUN should be within the value of (β) and (δ) . For details on how to calculate the number of differential tables and pair tables used by the programs other than Auto LUN, see the following manuals:

- For Business Copy, see *HP StorageWorks XP24000 Business Copy Software User's Guide*.
- For ShadowImage for Mainframe, see *Hitachi ShadowImage for z/OS User's Guide*.
- For Compatible FlashCopy and Compatible FlashCopy V2, see *HP StorageWorks XP24000 for Compatible FlashCopy Mirroring Software User's Guide*.
- For XP Snapshot, see *HP StorageWorks XP24000 Snapshot User's Guide*.

Calculating Differential Tables Required for Mainframe Volume Migration

When you migrate mainframe volumes, use the following expression to calculate the total number of the required differential tables and pair tables per migration plan.

$$\text{Total number of the differential tables per migration plan} = ((X) + (Y)) \times 15 \div (Z)$$

(X): The number of the cylinders of the volume to be migrated.*

(Y): The number of the control cylinders. (See [Table 5](#) on page 22)

(Z): The number of the slots that can be managed by a differential table.

(20,448)

* If the volume is divided by the VLL function, this value means the number of the cylinders of the divided volume.

Note that you should round up the number to the nearest whole number.

For example, in case of a volume which emulation type is 3390-3, and when provided that the number of the cylinders of the volume is 3,390 ((X) in the expression above), the calculation of the total number of the differential table is as follows.

$$(3,339 + 6) \times 15 \div (20,448) = 2.453785211$$

When you round up 2.453785211 to the nearest whole number, it becomes 3. Therefore, the total number of the differential table for one migration plan is 3 when emulation type is 3390-3.

One pair table can be used for 36 differential tables. Therefore, the number of pair tables for one migration plan is 1 when emulation type is 3390-3. Two pair tables are used if the emulation type is 3390-M and the number of volume cylinders is default number. The emulation type is 3390-M if multiple pair tables are used on a mainframe system.

The following table shows the number of the control cylinders according to the emulation types.

Table 5 The Number of the Control Cylinders According to the Emulation Types

Emulation Type	Number of the Control Cylinders
3380-3	7
3380-3A	7
3380-3B	7
3380-3C	7
3380-F	22
3380-K	7
3380-KA	7
3380-KB	7
3380-KC	7
3390-3	6
3390-3A	6
3390-3B	6
3390-3C	6
3390-3R	6
3390-9	25
3390-9A	25
3390-9B	25
3390-9C	25
3390-L	23
3390-LA	23
3390-LB	23
3390-M	53
3390-MA	53
3390-MB	53
3390-MC	53
3390-LC	23
NF80-F	22
NF80-K	7
NF80-KA	7
NF80-KB	7
NF80-KC	7

Calculating Differential Tables Required for Open-System Volume Migration

When you migrate open-system volumes, use the expression in [Table 6](#) on page 23 to calculate the total number of the required differential tables and pair tables per migration plan.

Table 6 The Total Number of the Differential Tables Per Migration Plan

Emulation Type	Expression
OPEN-3	Total number of the differential tables per migration plan = $((X) \div 48 + (Y) \times 15) \div (Z)$ (X): The capacity of the volume to be migrated. (kilobyte)* (Y): The number of the control cylinders. (See Table 7 on page 24) (Z): The number of the slots that can be managed by a differential table. (20,448)
OPEN-8	
OPEN-9	
OPEN-E	
OPEN-L	Note that you should round up the number to the nearest whole number. For example, if the emulation type of a volume is OPEN-3, and when provided that the number of the cylinders of the volume is 2,403,360 kilobytes (X) in the expression above), the calculation of the total number of the differential tables is as follows. $(2,403,360 \div 48 + 8 \times 15) \div 20,448 = 2.454518779$ When you round up 2.454518779 to the nearest whole number, it becomes 3. Therefore, the total number of the differential tables for one migration plan is 3 when emulation type is OPEN-3. One pair table can be used for 36 differential table. Therefore the total number of the pair tables for one migration plan is 1 when emulation type is OPEN-3.
OPEN-V	Total number of the differential tables per migration plan = $((X) \div 256) \div (Z)$ (X): The capacity of the volume to be migrated. (kilobyte)* (Z): The number of the slots that can be managed by a differential table. (20,448) Note that you should round up the number to the nearest whole number. For example, if the emulation type of a volume is OPEN-V, and when provided that the number of the cylinders of the volume is 3,019,898,880 kilobytes (X) in the expression above), the calculation of the total number of the differential tables is as follows. $(3,019,898,880 \div 256) \div 20,448 = 576.9014085$ When you round up 576.9014085 to the nearest whole number, it becomes 577. Therefore, the total number of the differential tables for one migration plan is 577 when emulation type is OPEN-V. One pair table can be used for 36 differential table. Therefore the total number of the pair tables for one migration plan is 17 when emulation type is OPEN-V. The emulation type OPEN-V can only be used, if you use multiple pair tables on the open system.

* If the volume is divided by the VLL function, this value means the capacity of the divided volume. Note that if the emulation type is OPEN-L, the VLL function is unavailable.

The following table shows the number of the control cylinders according to the emulation types.

Table 7 The Number of the Control Cylinders According to the Emulation Types

Emulation Type	Number of the Control Cylinders
OPEN-3	8 (5,760KB)
OPEN-8	27
OPEN-9	(19,440KB)
OPEN-E	19 (13,680KB)
OPEN-L	7 (5,040KB)
OPEN-V	0 (0KB)

3 Preparing for Auto LUN Operations

System Requirements

To use Auto LUN, you need:

- Storage system
- Auto LUN software (Performance Monitor is required)
- A Web client computer (intended for use as a Remote Web Console) connected to storage system via LAN.

To use Auto LUN, you use the Web client computer to log on to the SVP (web server). When you are logged on, the Remote Web Console program, which is a Java application program, will be downloaded to the web client computer. You can then perform Performance Monitor operations in the **Remote Web Console** window.

For a summary of Web client computer requirements, see the user's guide for the Remote Web Console.

Auto LUN operations require the Remote Web Console program, which is downloaded to your WWW client computer. Your WWW client computer must be connected to the storage system via LAN. Browser settings are also required on your WWW client computer. For details, see *HP StorageWorks XP24000 Remote Web Console User's Guide*.

Caution: Performance management operations (Performance Monitor, Auto LUN, and Performance Control) involve the collection of large amounts of monitoring data. This requires considerable Web client computer memory. It is therefore recommended that you exit the Remote Web Console program when not conducting performance management operations, to release system memory.

For details on how to install Performance Monitor, Auto LUN and Performance Control, see the manual *HP StorageWorks XP24000 Remote Web Console User's Guide*.

Storage Partition Administrators Limitations

Auto LUN is not available to storage partition administrators.

4 Using the Auto LUN GUI

Using the Auto LUN Windows

Auto LUN can be used to balance workloads among hard disk drives and thus remove bottlenecks from the system. Auto LUN can migrate volumes from the current parity group to another parity group. Volume migrations can be performed manually (by the system administrator) or automatically by Auto LUN.

In addition, Auto LUN can also migrate external volumes in external volume groups. However, external volumes can be migrated manually by the system administrator, but they cannot be migrated automatically by Auto LUN. For details on external volume groups and external volumes, see the *HP StorageWorks XP24000 Performance Monitor User's Guide*.

Note:

- From an open-system host, users can also use RAID Manager to perform manual volume migration by using commands. To perform volume migration by RAID Manager, Auto LUN should be installed on the storage system. For details on manual volume migration by using RAID Manager, see "[Sample Volume Migration](#)" on page 45. For details on RAID Manager, see *HP StorageWorks XP RAID Manager User's Guide*.
- The Auto LUN windows also display the statuses of volume migration performed by programs other than Auto LUN. Volumes being operated by these other programs cannot be operated by Auto LUN.
- If the user type of your user ID is *storage partition administrator*, you cannot use Auto LUN. For details on the limitations when using Auto LUN logged in as a storage partition administrator, see "[Storage Partition Administrators Limitations](#)" on page 25.

This section describes options, buttons and other components in Auto LUN windows.

Manual Plan Window of the Auto LUN

When you click the **Auto LUN** button in the **Performance Management** window, Auto LUN starts and the **Manual Plan** window of the Auto LUN is displayed. The **Manual Plan** window lets you create and execute manual migration plans.

For details on operations in this window, see "[Migrating Volumes Manually](#)" on page 42.

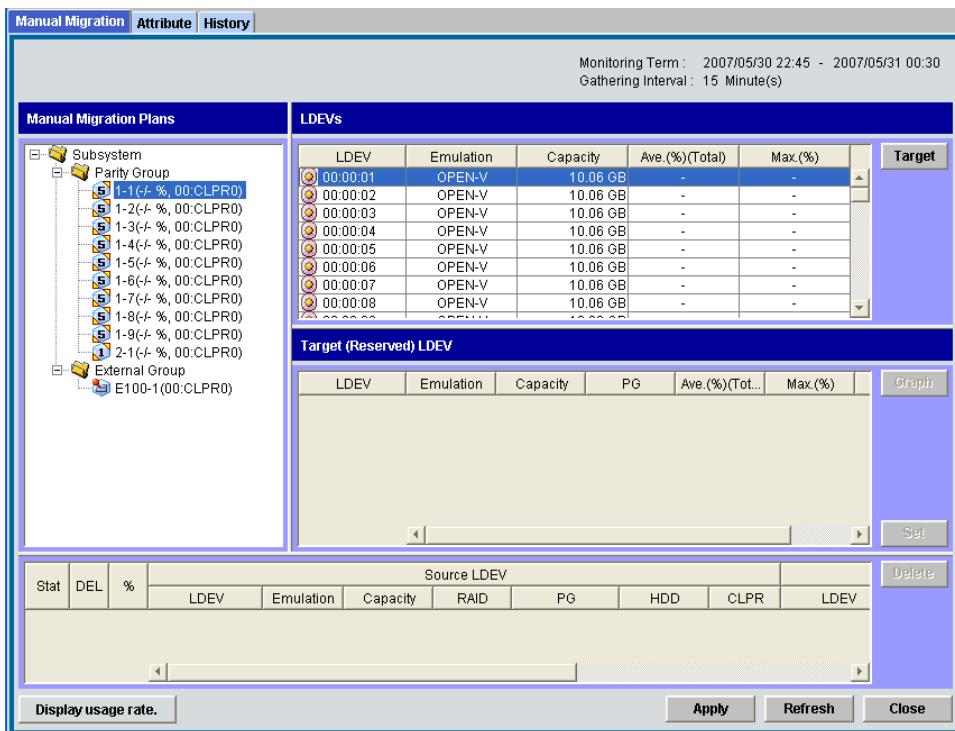


Figure 13 The Manual Plan Window of the Auto LUN

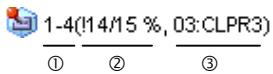
The **Manual Plan** window displays the following:

- **Monitoring Term:** Displays the monitoring period specified in the **Performance Management** window.
Auto LUN analyzes disk usage information collected by Performance Monitor, Performance Control, or Auto LUN during the monitoring period, and then calculates estimated usage rates of the source and target parity groups after a proposed volume migration. The program does not calculate estimated usage rates of external volume groups.
- **Gathering Interval:** Displays the collection interval in long range used in Performance Monitor. The interval in long range is fixed to 15 minutes.
- Tree: The tree lists parity groups and external volume groups in the storage system. The **Parity Group** folder contains icons of parity groups, and the **External Group** folder contains icons of external volume groups.
The graphics of parity group icons and external volume group icons indicate the RAID levels, and HDD classes.
The types of icons for parity groups and external volume groups are as follows.

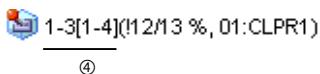
Parity group icons:

- indicates a fixed parity group when it appears below the **Parity Group** folder.
- indicates a RAID-1 parity group. The HDD class for this parity group is A.
- indicates a RAID-1 parity group. The HDD class for this parity group is B.
- indicates a RAID-1 parity group. The HDD class for this parity group is C.
- indicates a RAID-1 parity group. The HDD class for this parity group is D.
- indicates a RAID-5 parity group. The HDD class for this parity group is A.
- indicates a RAID-5 parity group. The HDD class for this parity group is B.
- indicates a RAID-5 parity group. The HDD class for this parity group is C.
- indicates a RAID-6 parity group. The HDD class for this parity group is A.
- indicates a RAID-6 parity group. The HDD class for this parity group is B.

-  indicates a RAID-6 parity group. The HDD class for this parity group is C.
-  indicates a RAID-6 parity group. The HDD class for this parity group is D.



- ① The parity group ID. The number before the hyphen is the frame number.
The number after the hyphen is the parity group number.
- ② The number before the slash is the average usage rate.
The number after the slash is the maximum usage rate.
If an exclamation mark (!) is displayed before a usage rate,
the reported parity group usage rate is likely to be inaccurate
If a plus mark (+) is displayed before a usage rate 0, such as "+0",
the usage rate is not completely 0 but less than 1.
- ③ The number and name of the CLPR corresponding to the parity group.
The number before the colon is the CLPR number. The name after the colon is the CLPR name.

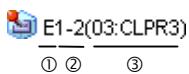


- ④ The parity group 1-3 is connected with the parity group 1-4.

Figure 14 Information about Parity Groups

External volume group icons:

-  indicates an external volume group when it appears below the **External Group** folder.
No volumes in this external volume group can be used as target volumes for manual migration.



- ① The letter "E" indicates an external volume group.
- ② The external volume group ID. The number before the hyphen is a frame number. The number after the hyphen is an external volume group number.
- ③ The number and name of the CLPR corresponding to the external volume group.
The number before the colon is the CLPR number. The name after the colon is the CLPR name.

Figure 15 Information about External Volume Groups

- **LDEVs:** A list of volumes in the parity groups you selected in the tree is indicated. Select a row to specify the **Source LDEV**.
Items displayed in the list are as follows.

LDEV	indicates the status of the volume. The number on the left of the first colon (:) from the left is the LDKC number. The number on the left of the second colon (:) from the left is the CU image number. The number on the right of the second colon is the LDEV number An icon showing the status of the volume is displayed on the left of the ID.
Emulation	Indicates the emulation type of the volume (LVI or LUN).
Capacity	Indicates the capacity of the volume.
Ave. (%)	Indicates the average usage rate for the parity group. If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the volumes may be moved by Auto LUN or formatted by HP StorageWorks XP Virtual LVI or Open Volume Management. If a plus mark (+) is displayed before 0, such as +0, the usage rate is not completely 0 but less than 1.
Max (%)	Indicates the maximum usage rate for the parity group. If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the volumes may be moved by Auto LUN or formatted by Virtual LVI or Open Volume Management.

The following are **volume icons**, contained in parity groups and external volume groups, that can appear in the tree.

Note: The volumes contained in an external volume group are called *external volumes*. In the tree of **Manual Plan** tab, volumes in a parity group and external volumes are expressed by the same icons.

Volume icons:

- indicates a normal volume that can be migrated to a different parity group but cannot be used as a migration destination.
- (blue) indicates a reserved volume of Auto LUN. This volume is reserved as a migration destination by Auto LUN.
When you specify a source volume in the **Manual Plan** window, Auto LUN checks these reserved volumes to find volumes that can be used as target volumes. If Auto LUN finds a reserved volume that can be used as target volumes, Auto LUN changes the volume icon to .
- (green) indicates a reserved volume of other programs. This volume is reserved by a program other than Auto LUN, therefore, Auto LUN cannot operation it.
- indicates a volume that can be used as a migration destination.
- indicates a volume that is being migrated, or a normal volume that is registered in a migration plan. A volume that is being migrated by a program other than Auto LUN is also indicated by this icon.

, (blue), (green), and . Among these icons, you can specify as a source volume.

- **Target Button:** After selecting the volume to migrate in the **Source LDEV**, click the **Target** button. This list of LDEVs in the **Target (Reserved) LDEV** are displayed.
- **Target (Reserved) LDEV:** The list of volumes that volume migration is possible corresponding to the **Source LDEV** appear. Select a row to specify the **Target LDEV**. Specify the target volume which is the destination volume in the text box. The usage rate for parity groups before volume migration and the estimated usage rate for parity groups after volume migration is displayed on the right of the text box.

Items displayed in the list are as follows.

LDEV	Indicates the volume ID. The number on the left of the first colon (:) from the left is the LDKC number. The number on the left of the second colon (:) from the left is the CU image number. The number on the right of the second colon is the LDEV number. An icon showing the status of the volume is displayed on the left of the ID.
Emulation	Indicates the emulation type of the volume (LVI or LUN).
Capacity	Indicates the capacity of the volume.
Ave. (%)	Indicates the average usage rate for the parity group. If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the volumes may be moved by Auto LUN or formatted by Virtual LVI or Open Volume Management. If a plus mark (+) is displayed before 0, such as +0, the usage rate is not completely 0 but less than 1.
Max (%)	Indicates the average usage rate for the parity group. If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the volumes may be moved by Auto LUN or formatted by Virtual LVI or Open Volume Management.

The displayed usage rates in the **Target (Reserved) LDEV** list are not usage rates of volumes but usage rates of parity groups that volumes are belonged. Comparing the usage rates of volumes in the **Target (Reserved) LDEV** list before volume migrations enables you easy to select the target volumes.

- **Graph** button displays the **Graph** window, which indicates the estimated usage rates of the specified **Source LDEV** and the **Target (Reserved) LDEV**.

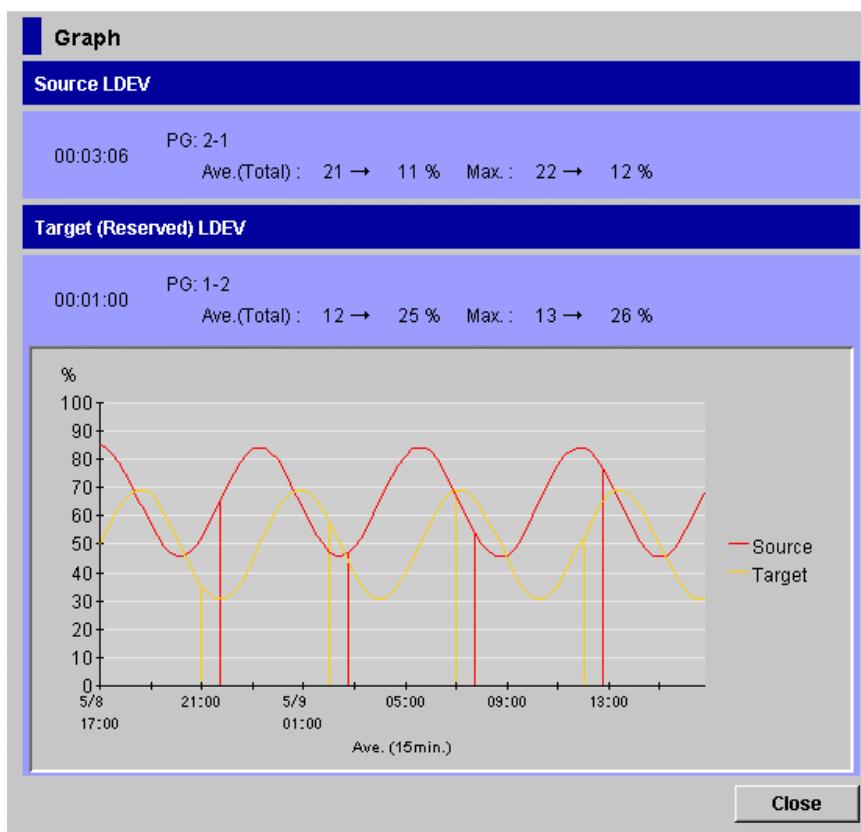


Figure 16 Graph Window

- **Source LDEV** lets you specify the source volume (that is, the volume that you want to migrate), On the right of the text box is the following:
 - The current usage rate for the parity group that the source volume belongs to.

- An estimated usage rate for the parity group after a proposed volume migration.

If you specify an external volume as a source volume, Auto LUN cannot calculate the estimated usage rate after migration. In this case, a hyphen (-) appears instead of a value.

- **Target (Reserved) LDEV** lets you specify the target volume (that is, the location to which you want to migrate the source volume). On the right of the text box is the following:

- The current usage rate for the parity group that the target volume belongs to.
- An estimated usage rate for the parity group after a proposed volume migration.

If you specify an external volume as a target volume, Auto LUN cannot calculate the estimated usage rate after migration. In this case, a hyphen (-) appears instead of a value.

- The line graph illustrates the past usage rates of the source volume and the target volume.
- The **Close** button closes the Graph window.

- The **Set** button adds a new manual migration plan to the list. The new manual migration plan consists of the volumes selected in **Source LDEV** and **Target (Reserved) LDEV**.

- List: Each row in the list indicates a manual migration plan, which is a pair of a source volume and the corresponding target volume, created in the **Manual Plan** window. A migration plan before being applied to the storage system is displayed in blue, and a migration plan after being applied (or during execution) to the storage system is displayed in black. Auto LUN performs multiple migration plans concurrently. When a migration plan was finished, the plan will disappear from the list.

A migration plan being executed by a program other than Auto LUN (such as RAID Manager) is also displayed in the list all together. Migration plans executed by other programs are not erased from the list automatically until the user operates for finish by using the program that performed the volume migration.

The **Stat** column displays an error code if an error occurs during execution of a migration plan. To view detailed information about an error, select and right-click the error code and then select **Detail** from the pop-up menu.

The **DEL** column displays the character D if you attempt to delete a migration plan that is waiting for execution, or already in progress. Migration plans indicated by D are actually deleted when you click the **Apply** button.

The % column indicates the progress of the manual migration. The progress value is updated once per minute.

The **Source LDEV** columns display information about source volumes:

- **LDEV** indicates the volume ID. The number on the left of the first colon (:) from the left is the LDKC number. The number on the left of the second colon (:) from the left is the CU image number. The number on the right of the second colon is the LDEV number. To the left of the device ID, the  icon is displayed which indicates that the volume is being migrated or is registered in a migration plan.
- **Emulation** indicates the emulation type of the volume.
- **Capacity** indicates the capacity of the volume.
- **RAID** indicates the RAID type.
- **PG** indicates the parity group ID or the external volume group ID. The number before the hyphen (-) is the frame number. The number after the hyphen is the group number.
Note: If the indicated parity groups are the **concatenated parity groups**, this item only displays the ID of the parity group at the top of the concatenated parity groups.
- **HDD** indicates the type of the hard disk drive.
- **CLPR** indicates the number and name of the CLPR corresponding to the parity group in the format *CLPR-number:CLPR-name*. For details on CLPRs, see *HP StorageWorks XP24000 Disk/Cache Partition User's Guide*.

The **Target LDEV** columns display information about target volumes:

- **LDEV** indicates the volume ID. The number on the left of the first colon (:) from the left is the LDKC number. The number on the left of the second colon (:) from the left is the CU image number. The number on the right of the second colon is the LDEV number. The blue  icon indicates a reserved volume of Auto LUN. The green  icon indicates a reserved volume of other programs.

- **RAID** indicates the RAID type.
- **PG** indicates the parity group ID or the external volume group ID. The number before the hyphen (-) is the frame number. The number after the hyphen is the group number.
- **HDD** indicates the type of the hard disk drive.
- **CLPR** indicates the number and name of the CLPR corresponding to the parity group in the format *CLPR-number:CLPR-name*. For details on CLPRs, see *HP StorageWorks XP24000 Disk/Cache Partition User's Guide*.
- **Owner** indicates the program which uses this volume as a target volume.
If **XP24000** is displayed, this is the target volume which is reserved by Remote Web Console.
If **Other [XX]** is displayed, this is the target volume which is reserved by RAID Manager or another program. *XX* is an ID which is given by this program.

A migration plan executed by a program other than Auto LUN is indicated by the  (green) icon displayed in the **LDEV** column and by **Other [XX]** displayed in the **Owner** column. You cannot delete such a migration plan by the **Delete** button.

- **Display usage rate.** displays the usage rate of the parity groups in the tree and displays the usage rate of the volumes in the **LDEVs** and the **Target (Reserved) LDEV**. If you click this button when usage rates are displayed, usage rates are not displayed in this window.
- The **Delete** button deletes the migration plan (that is, a row in the list) selected in the list. If you select a migration plan in blue (that is a migration plan that is not applied to the storage system yet) and click the **Delete** button, the migration plan is deleted immediately. If you select a migration plan in black (that is a migration plan that is waiting for execution or is being executed) and click the **Delete** button, the **DEL** column displays the character D and the selected migration plan will not be deleted until you click the **Apply** button. The **Delete** button does not take effect when both blue and black migration plans are selected. Confirm that only blue or black migration plans are selected before you select **Delete**.
Note: You cannot use the **Delete** button to delete a migration plan executed by a program other than Auto LUN (such as RAID Manager).
Caution: If you delete a migration plan which is being executed, the data in the target volume is not guaranteed.
- The **Apply** button applies manual migration plans in the list to the storage system to start volume migrations.
- The **Close** button closes the **Manual Plan** window.
- The **Refresh** button updates information in the **Manual Plan** window. The button updates the displaying of the tree after the execution of manual migration plan.

Attribute Window of the Auto LUN

When you click the **Auto LUN** button in the **Performance Management** window, Auto LUN starts. The **Attribute** window of Auto LUN lets you find out which parity group belongs to which HDD class. The **Attribute** window also lets you view detailed information about parity groups and external volume groups.

You must use the **Attribute** window when you reserve target volumes.

For details on operations in this window, see “[Reserving Migration Destinations For Volumes](#)” on page 41, “[Setting a Fixed Parity Group](#)” on page, and “[Changing the Maximum Disk Usage Rate for Each HDD Class](#)” on page.

Attribute							
	LDEV	Emulation	Capacity	Ave.(%)(...)	Max.(%)(...)	CLPR	Owner
00:00:01	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:02	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:03	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:04	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:05	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:06	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:07	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:08	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:09	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:0A	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:0B	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:0C	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:0D	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:0E	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:0F	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:10	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:11	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:12	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:13	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:14	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:15	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:16	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:17	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:18	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:19	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:1A	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:1B	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:1C	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:nn:nn:nn	OPEN-V	10.06 GB	-	-	00:CLPR0	-	

Figure 18 The Attribute Window of the Auto LUN

The **Attribute** window displays the following information:

- **Monitoring Term** displays the monitoring period specified in the **Performance Management** window.
- **Gathering Interval** displays the collection interval in long range used in Performance Monitor. The interval in long range is fixed to 15 minutes.
- Tree: The tree lists HDD classes and external volume groups. On the right of HDD classes, the upper limit (threshold) of the disk usage rate is displayed.

When you double-click an HDD class folder, a list of parity groups in that HDD class appears.

When you double-click the **External Group** folder, a list of external volume groups appears.

The icons of parity groups and external volume groups are as follows:

- The icon indicates a fixed parity group when it appears below an HDD class folder. This icon also indicates an external volume group when it appears below the **External Group** folder.
- indicates a RAID-1 parity group. The HDD class for this parity group is A.
- indicates a RAID-1 parity group. The HDD class for this parity group is B.
- indicates a RAID-1 parity group. The HDD class for this parity group is C.
- indicates a RAID-1 parity group. The HDD class for this parity group is D.
- indicates a RAID-5 parity group. The HDD class for this parity group is A.
- indicates a RAID-5 parity group. The HDD class for this parity group is B.
- indicates a RAID-5 parity group. The HDD class for this parity group is C.
- indicates a RAID-5 parity group. The HDD class for this parity group is D.
- indicates a RAID-6 parity group. The HDD class for this parity group is A.
- indicates a RAID-6 parity group. The HDD class for this parity group is B.
- indicates a RAID-6 parity group. The HDD class for this parity group is C.
- indicates a RAID-6 parity group. The HDD class for this parity group is D.

Parity group icons can represent a single parity group. Parity group icons can also represent two or more parity groups that are connected together. For example, if the text 1-3 appears on the

right of an icon, the icon represents the parity group 1-3. If the text 1-3[1-4] appears on the right of an icon, the icon represents two parity groups (that is, 1-3 and 1-4) that are connected together.

- List: Information in the list differs depending on the item that you select in the tree. When you select a class in the tree, the list displays information about parity groups in that class.

PG	HDD	Ave.(%)(Total)	Max. (%)	Total	Reserved	CLPR
5 1-1	DKR1B-J047FC	13	14	2	0	00:CLPR0
5 1-2	DKR1B-J047FC	!12	!13	2	0	01:CLPR1
5 1-3	DKR1B-J047FC	13	14	2	0	02:CLPR2
5 1-4	DKR1B-J047FC	!14	!15	2	0	03:CLPR3

Figure 19 Information about Parity Groups

- **PG** indicates the parity group ID. The number before the hyphen (-) is the frame number. The number after the hyphen is the group number.
The meaning of icons displayed here is the same as the icons in the tree.
- **Note:** If the indicated parity groups are the **concatenated parity groups**, this item only displays the ID of the parity group at the top of the concatenated parity groups.
- **HDD** indicates the type of the hard disk drive.
- **Ave.** indicates the average usage rate for the parity group.
If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the configuration has changed (for example, volumes have been moved by Auto LUN or changed by Virtual LVI or Open volume Management).
If a plus mark (+) is displayed before a usage rate 0, such as +0, the usage rate is not completely 0 but less than 1.
- **Max.** indicates the maximum usage rate for the parity group.
If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the configuration has changed (for example, volumes have been moved by Auto LUN or changed by Virtual LVI or Open Volume Management).
- **Total** indicates the total number of volumes in the parity group.
- **Reserved** indicates the number of reserved volumes.
- **CLPR** indicates the number and name of the CLPR corresponding to the parity group in the format CLPR-number:CLPR-name. For details on CLPRs, see *HP StorageWorks XP24000 Disk/Cache Partition User's Guide*.

When you select a parity group in the tree, the list displays information about volumes in that parity group.

	LDEV	Emulation	Capacity	Ave.(%)(...)	Max. (%)	CLPR	Owner
00:00:01	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:02	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:03	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:04	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:05	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:06	OPEN-V	10.06 GB	-	-	00:CLPR0	-	
00:00:07	OPEN-V	10.06 GB	-	-	00:CLPR0	-	

Figure 20 Information about Volumes in a Parity Group

- **LDEV** indicates the volume ID. The number on the left of the first colon (:) from the left is the LDKC number. The number on the left of the second colon (:) from the left is the CU image number. The number on the right of the second colon is the LDEV number.
-  indicates a normal volume that can be migrated but cannot be used as a migration destination. You cannot change this volume to a reserved volume ().

 indicates a normal volume that can be migrated. If you change the attribute of this volume to a reserved volume () , this volume can be used as a migration destination (that is, target volume).

 (blue) indicates a *reserved volume* of Auto LUN. This volume is reserved as a migration destination by Auto LUN. A reserved volume cannot be migrated. You can change this volume to a normal volume () , and then you can use this volume as a source volume.

 (green) indicates a *reserved volume* of other programs. This volume is reserved by a program other than Auto LUN (such as RAID Manager), therefore, Auto LUN cannot operate it. You cannot change the attribute of this volume.

Note: The list does not display volumes that are used as a LUSE.

- **Emulation** indicates the emulation type of the volume.
- **Capacity** indicates the capacity of the volume.
- **Ave.** indicates the average usage rate for the volume.
If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the configuration has changed (for example, volumes have been moved by Auto LUN or changed by Virtual LVI or Open Volume Management).
If a plus mark (+) is displayed before a usage rate 0, such as +0, the usage rate is not completely 0 but less than 1.
- **Max.** indicates the maximum usage rate for the volume.
If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the configuration has changed (for example, volumes have been moved by Auto LUN or changed by Virtual LVI or Open Volume Management).
- **CLPR** indicates the number and name of the CLPR corresponding to the parity group which the volume belongs to, in the format *CLPR-number:CLPR-name*. For details on CLPRs, see *HP StorageWorks XP24000 Disk/Cache Partition User's Guide*.
- **Owner** indicates the program which reserved this volume.
If **XP24000** is displayed, this is the reserved volume which is reserved by Remote Web Console.
If **Other [XX]** is displayed, this is the reserved volume which is reserved by RAID Manager or another program. XX is an ID which is given by this program.
If a hyphen (-) is displayed, this volume is not reserved and this is a normal volume.

When you select **External Group** in the tree, the list displays information about external volume groups.

ExG	HDD	Total	Reserved	CLPR
 E1-1	External	2	0	02:CLPR2
 E1-2	External	2	0	03:CLPR3
 E1-3	External	2	0	00:CLPR0
 E1-4	External	2	0	01:CLPR1

Figure 21 Information about External Volume Groups

- **ExG** indicates the ID of the external volume group. The letter **E** stands for an external volume group. The number before the hyphen (-) is the frame number. The number after the hyphen is the group number.
External volume groups are displayed with the  icon.
- **HDD** indicates the type of the hard disk drive.
- **Total** indicates the total number of volumes in the external volume group.
- **Reserved** indicates the number of reserved volumes.
- **CLPR** indicates the number and name of the CLPR corresponding to the external volume group in the format *CLPR-number:CLPR-name*. For details on CLPRs, see *HP StorageWorks XP24000 Disk/Cache Partition User's Guide*.

When you select an external volume group in the tree, the list displays information about external volumes (that is volumes in the external volume groups).

	ExLDEV	Emulation	Capacity	CLPR	Owner
①	00:07:FA #	OPEN-V	2.28 GB	03:CLPR3	-
②	00:07:FB #	OPEN-V	2.28 GB	03:CLPR3	-
③	00:07:FC #	OPEN-V	2.28 GB	03:CLPR3	-
④	00:07:FD #	OPEN-V	2.28 GB	03:CLPR3	-

Figure 22 Information about External Volumes

- **ExLDEV** indicates the ID of the external volume. The number on the left of the first colon (:) from the left is the LDKC number. The number on the left of the second colon (:) from the left is the CU image number. The number on the right of the second colon is the LDEV number.
The meaning of icons (①, ②, ③, ④ (blue), and ⑤ (green)) displayed at the left of IDs have the same meaning as the icons for volumes in parity groups.
- **Note:** The list does not display volumes that are used as a LUSE.
- **Emulation** indicates the emulation type of the volume.
- **Capacity** indicates the capacity of the volume.
- **CLPR** indicates the number and name of the CLPR corresponding to the external volume group which the external volume belongs to, in the format *CLPR-number:CLPR-name*. For details on CLPRs, see *HP StorageWorks XP24000 Disk/Cache Partition User's Guide*.
- **Owner** indicates the program which reserved this volume, if it is reserved. The displayed item is the same as that of volumes in parity groups.
- The **Apply** button applies the settings in the **Attribute** window to the storage system.
- The **Close** button closes the **Attribute** window.

History Window of Auto LUN

When you click the **Auto LUN** button in the **Performance Management** window, Auto LUN starts and the **Auto LUN** window is displayed. The **Auto LUN History** window includes the History window, which displays information about manual migration operations in the past. For example, you can find out when migration operations took place and also find out whether migration operation finished successfully.

For details on operations in this window, see “[Viewing the Migration History Log](#)” on page 43.

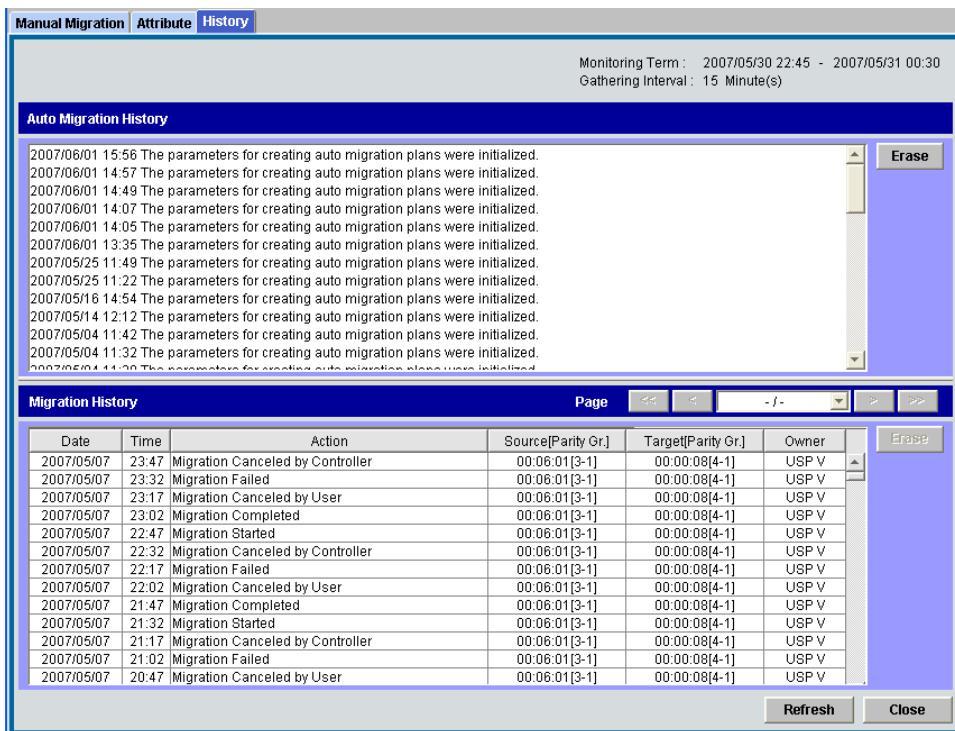


Figure 23 The History Window of the Auto LUN

Note: Auto Migration History will be supported in a future release.

The **History** window displays the following information:

- **Monitoring Term** displays the monitoring period specified in the **Performance Management** window.
 - **Gathering Interval** displays the collection interval in long range used in Performance Monitor. The interval in long range is fixed to 15 minutes.
 - **Migration History** displays logs of all the events about the manual volume migration. This list also displays logs of migration plans executed by programs other than Auto LUN. The list displays the following information:
 - **Date** displays the date when the event occurs.
 - **Time** displays the time when the event occurs.
 - **Action** displays the event (For details, see [Table 9](#) on page 44 in section ["Viewing the Migration History Log"](#) on page 43).
 - **Source[Parity Pr.]** displays the source volume and the parity group (or the external volume group).
- Note:** The parity group ID (or the external volume group ID) might be displayed as [XX-XX]. This means the parity group (or the external volume group) does not exist in the current configuration.
- **Target[Parity Pr.]** displays the target (destination) volume and the parity group (or the external volume group)
- Note:** The parity group ID (or the external volume group ID) might be displayed as [XX-XX]. This means the parity group (or the external volume group) does not exist in the current configuration.
- **Owner** displays the program which executed this migration plan.
If XP24000 is displayed, this is the migration plan which is executed by Remote Web Console. If Other[XX] is displayed, this is the migration plan which is executed by a program product other than Remote Web Console (such as RAID Manager). XX is an ID which is given by this program product.
 - The **Erase** button lets you erase the entire information.

Notes:

- The **Source[Parity Gr.]** and **Target[Parity Gr.]** columns also display the information about external volume group migration, though these groups are not parity groups.
- If the source parity groups and target parity groups are the **concatenated parity groups**, the list only displays the ID of the parity group at the top of the concatenated parity groups.
- The Page drop-down list displays the pages of the history, up to 256 pages. 2,408 or less cases are displayed in one page.
- The << button displays the page of the latest migration history that are already gathered.
- The < button Displays the previous page of the displayed migration history.
- The Drop-down list displays the pages of the history, up to 20 pages.
- The > button displays the next page of the displayed migration history.
- The >> button display the page of the oldest migration history.
- The **Refresh** button updates information in the **History** window.
- The **Close** button closes the **History** window.

5 Auto LUN Operations

Starting Auto LUN

To start Auto LUN, take the following steps:

1. Ensure that the Remote Web Console main window is in Modify mode.
The Remote Web Console main window is in Modify mode if the background color of the  (pen tip) icon is light yellow. If the background color is gray, the window is in View mode and you must change it to Modify mode by taking the following steps:
 - a. Verify whether the background color of the lock icon  is blue. If the background color is red , you will not be able to switch from View mode to Modify mode. Wait for a while and click the  button. If the background color turns blue, you can go to the next step.
 - b. Select the  icon. A message asks if you want to change the mode.
 - c. Select **OK** to close the message.The background color of the icon changes to light yellow (). The mode changes to Modify mode. The background color of the lock icon becomes red ().
2. Ensure that the **Physical** tab is active in the **Performance Management** window.
3. In the drop-down list at the right of **Monitoring Data**, select **longrange**. The **Auto LUN** button is activated.
4. Select the **Auto LUN** button. The Auto LUN windows is displayed.

Reserving Migration Destinations For Volumes

To migrate volumes, you must reserve disk spaces (actually, volumes) that can be used for migration destinations. You must reserve volumes regardless of migration methods (manual migration or automatic migration). Migration will not take place when no volume is reserved.

Throughout the storage system documentation set, the term reserved volume is used to refer to a volume that is reserved for use as a migration destination. Volumes reserved by Auto LUN are indicated by blue  icons. Also, the term normal volume is sometimes used to refer to a volume that is not reserved as a migration destination.

To reserve a volume as a migration destination:

1. Start Auto LUN (see “[Starting Auto LUN](#)” on page 41) and select the **Attribute** tab in the **Auto LUN** window ([Figure 18](#) on page 34).
2. In the tree, locate a volume that you want to use as a migration destination.
To locate a volume, first double-click an HDD class (or the **External Group** folder) in the tree to display a list of parity groups (or external volume groups). Next, click a parity group (or an external volume group).
The list on the right displays a list of volumes in that group.
3. In the list on the right of the tree, locate volumes preceded by the  icon. From those volumes, select the desired volume and right-click it.
Note: To reserve two or more volumes, you can select the desired volumes and right-click the selection.
4. Select **Reserved LDEV** from the pop-up menu.
The icon changes to a blue .

5. Select the **Apply** button.

The settings in the window are applied to the storage system. The specified volume is reserved as a migration destination.

Tip: If you right-click a volume preceded by the blue  icon (reserved volume of Auto LUN) and then choose **Normal LDEV** from the pop-up menu, the selected icon changes to  and you will not be able to use the volume as a migration destination.

Notes:

- When you click the **Apply** button one time, up to 64 volumes can be reserved as migration destinations. If you click the **Apply** button to reserve more than 64 volumes, an error occurs. To reserve more than 64 volumes, you must follow the above procedure at least twice. For example, if you want to reserve 100 volumes, you need to reserve 64 or fewer volumes and then reserve the remaining volumes.
- A volume preceded by the green  icon is reserved by a program other than Auto LUN and you cannot change the attribute of the volume by using the pop-up menu.

Migrating Volumes Manually

To migrate volumes manually, you must create migration plans. A migration plan is a pair of a source volume and the corresponding target (destination) volume. A migration plan is prepared for each volume that you want to migrate.

In manual migration, you can specify an external volume in an external volume group as a source volume or a target volume of migration.

Caution: When performing a series of manual migration operations, remember that the configuration changes after each migration is complete.

To migrate volumes manually:

- Start Auto LUN (see “[Starting Auto LUN](#)” on page 41) and select the **Manual Plan** tab in the Auto LUN window ([Figure 13](#) on page 28).
- In the tree, double-click a folder icon of parity group (or an external volume group). A list of parity groups or external volumes is displayed.
A list of volumes in that parity group (or external volume group) is displayed. Volumes that can be migrated is indicated by the  icon. Usage rate of the parity groups are displayed if you select the **Display usage rate** button.
Note: the **Display usage rate** button is toggable. If the button is held down, usage rates are displayed. If the button is not held down, usage rates are not displayed. Usage rates are not displayed in initial state of this tab.
- Select the parity group icon that includes the volume you want to migrate.
The list of volumes that are belonged to the parity group is displayed in the **LDEVs** list.
- Select the volume you want to migrate from the **LDEVs** and click the **Target** button.
Auto LUN finds the volumes that can be used as target volumes and displays the list of the volumes in the **Target (Reserved) LDEV** list.
- Select the target volume from the volumes displayed in the **Target LDEV** and click the **Graph** button.
The **Graph** window appears and the estimated value of the performance after migration of the selected volume is displayed.
- Check the estimated results in **Source LDEV**, **Target LDEV** on the **Graph** window and click the **Close** button.
The **Graph** window is closed.
 - If you anticipate getting the desired disk performance, go to the next step:
 - If not, return to step 2 or 3 to change the source and target volumes.
 - To migrate the volumes that are already decided, you can skip the operations step 5 and step 6.
- Select the **Set** button.

A new migration plan, consisting of the specified source and target volumes, is added to the list. The new migration plan is displayed in blue.

Note: Throughout the storage system documentation set, the term migration plan is used to refer to a pair of a source volume and the corresponding target volume.

8. To create and execute more than one migration plan, repeat steps 2 through 7 to add migration plans. The newly added migration plan will appear below the existing migration plans.

9. Select the **Apply** button.

The migration plans are applied to the storage system and the migrations start. Auto LUN performs multiple migration plans concurrently. The font color of the migration plans during execution change from blue to black.

When a volume starts migration, the % column displays the progress of the migration. When the migration finished, the migration plan of that volume will disappear from the list.

If an error occurs during migration, an error code is displayed in the **Stat** column. To view detailed information about the error, select and right-click the error code and then select **Detail** from the pop-up menu.

Notes:

- Up to eight migration plans can be applied with each click of the **Apply** button. To create and apply more than eight migration plans, use the **Apply** button several times. While executing the migration plans, you can apply additional migration plans.
- The number of the migration plans that can be executed concurrently might be restricted depending on the usage of other storage system programs, and also depending on the emulation types and sizes of the migrated volumes. For details, see the explanation of "Number of migration plans that can be executed concurrently" in section "[Auto LUN](#)" on page 16 and also see "[How to Calculate the Number of Concurrent Migration Plans](#)" on page 20.

Related topics:

- To delete a migration plan, select a migration plan in the list and then click the **Delete** button.
- If you select a migration plan in black (a migration plan that is waiting for execution or being executed) and then click the **Delete** button, the character D appears in the **DEL** column, and the migration plan will not be deleted until you click the **Apply** button.
- You cannot use the **Delete** button to delete migration plans executed by programs other than Auto LUN. These migration plans are indicated by the  (green) icon displayed in the **LDEV** column and by **Other[XX]** displayed in the **Owner** column in the **Target LDEV** list. These migration plans also disappear from the list when the migration finished.

Cautions:

- If you delete a migration plan that is being executed, the data in the target volume will not be guaranteed.
- When an error condition exists in the Storage system, resource usage can increase or become unbalanced. Do not use usage statistics collected during an error condition as the basis for planning Auto LUN operations.

Viewing the Migration History Log

The **History** window ([Figure 23](#) on page 38) of the **Auto LUN** displays logs of manual migration operations.

To view migration logs:

1. Start Auto LUN to open the Auto LUN windows.
2. Select the **History** tab of the Auto LUN windows ([Figure 23](#) on page 38).
 - To view logs of manual migration operations, look at **Migration History**. For messages that might appear in **Migration History**, see [Table 9](#) on page 44.

Note: Messages in the **History** window may not be arranged in the order that corresponding events take place.

Table 9 Messages in the Migration Logs (displayed in the Action column)

Message	Meaning
Migration Started	The migration operation started.
Migration Completed	The migration operation completed successfully.
Migration Canceled by User	The migration operation was canceled by the user.
Migration Failed	The migration operation failed.
Migration Canceled by Controller	The migration operation was canceled by Auto LUN (for example, volume usage rate exceeded specified maximum).
Migration Canceled by Controller (Business Copy) Migration Canceled by Controller (Continuous Access (*1)) Migration Canceled by Controller (Data Migration (*2)) Migration Canceled by Controller (Continuous Access Journal (*3)) Migration Canceled by Controller (CC(*5))	Because each program product started processing, the migration operation was canceled by Auto LUN.

*1 : It indicates Continuous Access.

*2 : It indicates HP Online Data Migration.

*3 : It indicates Continuous Access Journal.

*4 : It indicates IBM 3990 Concurrent Copy.

6 Using RAID Manager for Manual Volume Migration

In the environment where Auto LUN is installed on the storage system, users can use RAID Manager to perform manual volume migration from an open-system host. This appendix explains the procedure and notes for using RAID Manager to perform manual volume migration.

Sample Volume Migration

This section illustrates with a example the procedure when performing manual volume migration by using commands of RAID Manager. In this example, It is assumed that `group1` means the group name in the RAID Manager configuration definition file and `pair1` means the name of the volume which pair is target of the operation. For details on RAID Manager operation, see *HP StorageWorks XP RAID Manager User's Guide*.

To perform manual volume migration by using RAID Manager:

1. Start RAID Manager.
2. Type the following command for a SMPL pair to start volume migration:
`paircreate -g group1 -d pair1 -m cc -vl`
When volume migration starts, the status of the pair changes to COPY.
3. Type the following command to check the status of the pair:
`pairdisplay -g group1 -d pair1 -fcex`
When the volume migration completed, the status of the pair becomes PSUS. When the volume migration failed, the status of the pair becomes PSUE.
4. When the status of the pair becomes PSUS or PSUE, return the pair status to SMPL by the following command:
`pairsplit -S -g group1 -d pair1`

Note: When the migration failed (the status of the pair becomes PSUE), repeat step 2 and 3. When it still becomes PSUE, contact the service engineer.

The status transition chart of a pair when the volume migration is performed by using RAID Manager is shown below. The statuses in this chart can be displayed by typing `pairdisplay` command of RAID Manager.

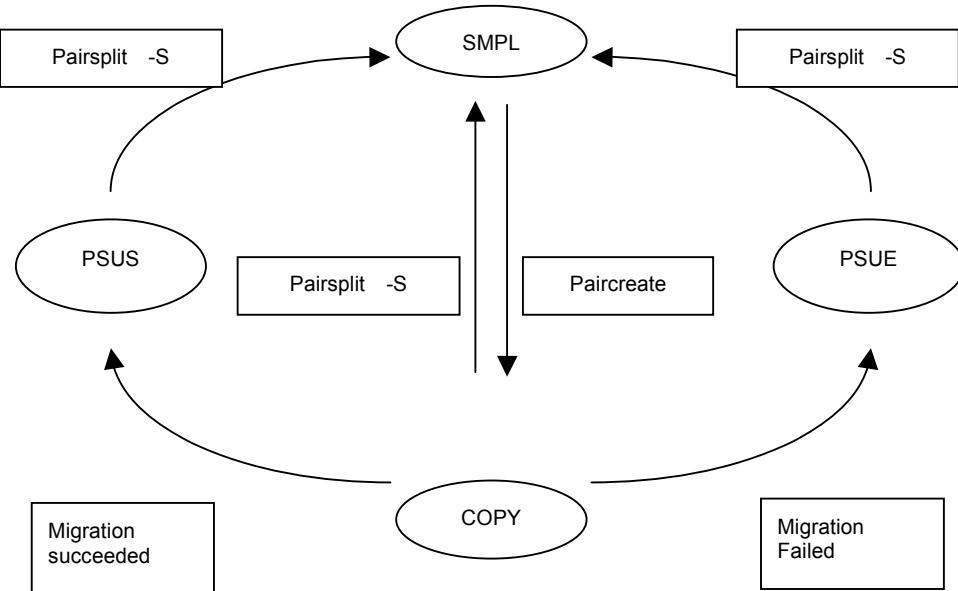


Figure 25 Status Transition Chart of a Pair during Volume Migration by RAID Manager

Volume Migration Errors

When you perform volume migration by using RAID Manager, note the following:

- A reserved volume of Auto LUN cannot be used when you perform volume migration by using RAID Manager.
- A migration plan being executed by Auto LUN cannot be canceled from RAID Manager.
- A migration plan created by Auto LUN cannot be displayed by using RAID Manager.
- Before checking RAID Manager settings in a Remote Web Console window, you must select the **All Refresh** button.
- Migration cannot be performed when either of the specified volumes is a LUSE volume.
- When you try volume migration or migration cancellation by using RAID Manager, EX_CMDRJE might be displayed and the command might be refused depending on the condition in the DKC. The following table shows the error codes, causes of errors, and measures for such a case.

Table 10 Errors during Auto LUN or Migration Cancellation by using RAID Manager

Error Code	Cause	Measure
2051	The migration target volume is being used with Data Retention Utility.	Release the volume from Data Retention Utility, and then perform the volume migration.
2055	The migration target volume is being used with Continuous Access Journal.	Release the volume from Continuous Access Journal, and then perform the volume migration.
2056	The migration source volume is being used with Continuous Access Journal.	Release the volume from Continuous Access Journal, and then perform the volume migration.
2058	The migration target volume and the migration source volume belong to the same parity group.	This volume migration cannot be executed. Check the configuration definition file.

Error Code	Cause	Measure
2301	Auto LUN is not installed on the storage system.	Install Auto LUN, and then perform the volume migration.
2306	The LBA size does not match between the migration target volume and the migration source volume.	This volume migration cannot be executed. Check the configuration definition file.
2309	The maximum number of pairs which can be set in the storage system is exceeded.	Reduce the number of pairs set in the storage system, and then perform the volume migration.
2311	The migration target volume is already reserved by Auto LUN.	Cancel the reservation by Auto LUN, and then perform the volume migration.
2312	The migration source volume is online with the host.	Make the migration source volume offline from the host, and then perform the volume migration.
232F	The migration source volume is already specified as the target volume of Auto LUN.	Release the volume from Auto LUN, and then perform the volume migration.
2331	Either of the following causes can be considered: 1) The migration source volume is already reserved by Auto LUN. 2) The number of slots does not match between the migration target volume and the migration source volume.	Do the following measures respectively: 1) Cancel the reservation by Auto LUN, and then perform the volume migration. 2) This volume migration cannot be executed. Check the configuration definition file.
2332	You cannot add pair settings any more to the volume specified as the migration source.	Reduce the number of pair settings of the specified volume, and then perform the volume migration.
2333	The volume specified by the migration cancellation is not a migration source volume	It is trying to perform the migration cancellation of the pair which is not migrating. Check the configuration definition file.
2336	The emulation type does not match between the migration target volume and the migration source volume.	This volume migration cannot be executed. Check the configuration definition file.
2337	The migration source volume is a leaf volume of Business Copy.	Release the Business Copy pair, and then perform the volume migration.
233B	The migration target volume is a primary volume of Business Copy.	Release the Business Copy pair, and then perform the volume migration.
233C	The migration target volume is a secondary volume of Business Copy.	Release the Business Copy pair, and then perform the volume migration.
2342	The migration target volume is already specified as the target volume of Auto LUN.	Release the volume from Auto LUN, and then perform the volume migration.
2344	The volume specified by the migration cancellation is not a migration target volume	It is trying to perform the migration cancellation of the pair which is not migrating. Check the configuration definition file.
2346	The migration target volume is a primary volume of Continuous Access.	Release the Continuous Access pair, and then perform the volume migration.
2347	The migration target volume is a secondary volume of Continuous Access.	Release the Continuous Access pair, and then perform the volume migration.

Error Code	Cause	Measure
234B	The migration target volume is already specified as the source volume of Auto LUN.	Release the volume from Auto LUN, and then perform the volume migration.
2355	The setting of VLL is different between the migration target volume and the migration source volume.	This volume migration cannot be executed. Check the configuration definition file.
2365	The migration source volume is a primary volume of IBM 3990 Concurrent Copy (CC).	Release the IBM 3990 Concurrent Copy pair, and then perform the volume migration.
2366	The migration target volume is a primary volume of IBM 3990 Concurrent Copy.	Release the IBM 3990 Concurrent Copy pair, and then perform the volume migration.
2368	The migration source volume is a primary volume of a Continuous Access pair which is not in the SUSPEND status.	Put the Continuous Access pair in the SUSPEND status or release the Continuous Access pair. Then, perform the volume migration.
236B	The migration source volume is a volume of a Business Copy pair which is in the SP-PEND status.	Perform the volume migration after the Business Copy pair is changed to the SPLIT status.
2372	The migration source volume is being formatted.	Perform the volume migration after formatting is completed.
2373	The migration source volume is a command device.	This volume migration cannot be executed. Check the configuration definition file.
237C	The migration source volume is an external volume specified as a primary volume of Continuous Access.	Release the Continuous Access pair, and then perform the volume migration.
2382	The migration target volume is being formatted.	Perform the volume migration after formatting is completed.
2383	The migration target volume is a command device.	This volume migration cannot be executed. Check the configuration definition file.
2389	Cache Residency is set on the migration source volume.	Release the setting of Cache Residency, and then perform the volume migration.
238A	Cache Residency is set on the migration target volume.	Release the setting of Cache Residency, and then perform the volume migration.
238B	The migration source volume and the migration target volume is specified as LUSe volumes.	This volume migration cannot be executed. Check the configuration definition file.
238C	The migration target volume is a reserved volume of Business Copy.	Cancel the reservation by Business Copy, and then perform the volume migration.

7 Troubleshooting

This chapter gives troubleshooting information on Auto LUN. For troubleshooting information on Remote Web Console, see the following documents:

- *HP StorageWorks XP24000 Remote Web Console User's Guide*
- *HP StorageWorks XP24000 Remote Web Console Error Codes*

Troubleshooting Auto LUN

- When an error message is displayed on the Remote Web Console computer:
The Auto LUN software displays error messages on the Remote Web Console computer when error conditions occur during Auto LUN operations.
If you need to call HP technical support, make sure to provide as much information about the problem as possible, including the error codes. For information on other error codes displayed on the Remote Web Console computer, see the *HP StorageWorks XP24000 Remote Web Console Error Codes* document.

Calling HP Technical Support

If you need to call the HP technical support, be sure to provide as much information about the problem as possible. Include the circumstances surrounding the error or failure and the exact content of any error codes and/or messages displayed on the Remote Web Console.

For worldwide technical support information, see the HP support website:

<http://www.hp.com/support>

A Acronyms and Abbreviations

Table 11 Acronyms and Abbreviations

ACP	array control processor
CU	control unit (logical control unit)
DASD	direct-access storage device
DFW	DASD fast write
DKA	disk adapter
DKCMAIN	Disk Controller Main
ESCON	Enterprise System Connection (IBM trademark for optical channels)
LAN	local-area network
LDEV	logical device
LU	logical unit
LUN	logical unit number
NVS	nonvolatile storage
PC	personal computer
PDEV	physical device
P-VOL	primary volume
RAID	redundant array of independent disks
SM	shared memory
SMPL	simplex
S-VOL	secondary volume
SVP	service processor
TC	Continuous Access
TCz	TrueCopy for Mainframe

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